CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

A. General description of project activity

B. Application of a baseline and monitoring methodology

C. Duration of the project activity / crediting period

D. Environmental impacts

E. Stakeholders' comments

Annexes

Annex 1: Contact information on participants in the project activity

Annex 2: Information regarding public funding

Annex 3: Baseline information

Annex 4: Monitoring plan

SECTION A. General description of project activity

A.1. Title of the project activity:

Tombwa Wind Farm CDM Project - Angola

Version 01

Date: 20/07/2011

A.2. Description of the project activity:

The project activity consists of a wind energy conversion into electrical energy, providing an alternative source of renewable energy. The energy generated will be integrated in the Southern Angolan interconnected grid, which aims to generate energy solutions of low impact on the environment. The project developer is the *Empresa Nacional de Eletricidade*[1] (hereafter named "ENE"), which is a public company responsible for the managing and operation of the energy sector, including the generation, transmission and distribution of electricity in Angola, working in affiliation of the Ministry of Energy and Water.

The wind farm, located in *Tombwa* Municipality – *Namibe* Province, have a total installed capacity of 100 MW and will produce power through 50 wind turbines, *Vestas* V-90 model, with heights of 80 and 95 meters, and a rated individual potency of 2MW.

It is called wind energy the kinetic energy contained in moving air masses (wind). Its use occurs through the conversion of kinetic energy into translational kinetic energy of rotation, with the use of wind turbines, to generate electricity.

The assessment of a wind potential of a region requires systematic work of collecting and analyzing data on speed and wind regime. Generally, an accurate assessment requires detailed studies to provide a first estimative of gross potential or theoretical use of wind energy.

The project developer conducted all the studies to estimate the full potential of the project, as well as all the technical studies for the implementation of the project. Possessing all the necessary studies and authorized by the government, the initial implementation phase were commenced.

The wind farm has a main objective of generate electricity to the interconnected national system. This energy will reduce the amount of energy produced by the power plants that runs using fossil fuel, inserting renewable energy into the system. Thus, helping to reduce emissions of greenhouse gases and encourage the use of alternative energy technologies.

With the growing energy demand in Angola, this type of project is seen as priority in the Angolan energy sector strategy. As mostly of the Angolan's matrix are hydro and thermal power plants, it is important to diversify. Being an environmentally friendly technology, the project contributes to sustainable development of Angola, for example:

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[1] The ENE was created by the Official National Decree n° 29/98 in September 04, 1998 with the purpose to produce, distribute and commercialize electricity based on international quality standards and reliability.

- Producing renewable energy and directing its entire production to the Angolan electrical system, the development of the project activity will not only reduce emissions of greenhouse gases but also will mitigate local pollution caused by atmospheric emissions from burning fossil fuel.

- The project activity will contribute to diversify the type of energy produced in Angola, reducing dependence on energy generated by fossil fuels and hydroelectric plants.

- The successful development of the proposed project will serve as an example for the expansion of this technology locally and nationally.

Moreover, the project activity in question contributes to promoting economic development in the region, as it enables the creation of jobs at different levels of expertise, both during construction and in operation phase (i.e. measurement of wind, services related to power generation, topographical, geological and environmental studies, civil works etc.).

The project would come on-stream from January 2013. The project proponents estimate that 1,100,807 tons of CO2 would be reduced from the baseline scenario over the 07 years of crediting period as a result of the construction of the project.

Contribution to sustainable development

With the growing energy demand in Angola, this type of project is seen as priority in the Angolan energy sector strategy. Being an environmentally friendly technology, the project contributes to sustainable development of the country and will serve as an example for the expansion of this technology locally and nationally.

As per the social perspective, the project will demand 2,700 direct employees, mostly of them locally recruited. Additionally, during the operational phase of the project, several other jobs opportunities will be created. It is perceived that the implementation of the project will have a positive impact on the region, being a conductor for future different investments and consequently imposing itself a major role on the local and national development related to the income distribution, offer of basic public services and access to specialized knowledge.

In addition, the production of renewable energy and the dispatching of the entire production to the Angolan electrical system will not only reduce emissions of greenhouse gases (GHGs) but also will mitigate local pollution caused by atmospheric emissions from burning fossil fuel. On the economical perspective, the project will lead to a diminishing of the demand from fossils fuels, which are a very expensive item within the national economy.

A.3. Project participants:

Name of the Party involved	Private and/or public entity (ies) project participants	Kindly indicate if the Party involved whishes to be considered as project participant
Republic of Angola	*Empresa Nacional de Eletricidade - ENE*	Yes
Republic of Angola	*Angola Carbon S.A.*	Yes

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Republic of Angola.

A.4.1.2. Region/State/Province etc.:

Namibe Province.

A.4.1.3. City/Town/Community etc.:

Municipality of Tombwa.

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The Tombwa project activity is located on the Municipality of Tombwa, 1,234 km east of Luanda, the National Capital. The Municipality of Tombwa is geographically limited by the Municipalities of Namibe and Virei on the north side and by the Curoca Municipality.

The specific geographical coordinates of the project site are:

Latitude	15° 50´ S
Longitude	11° 50´ E

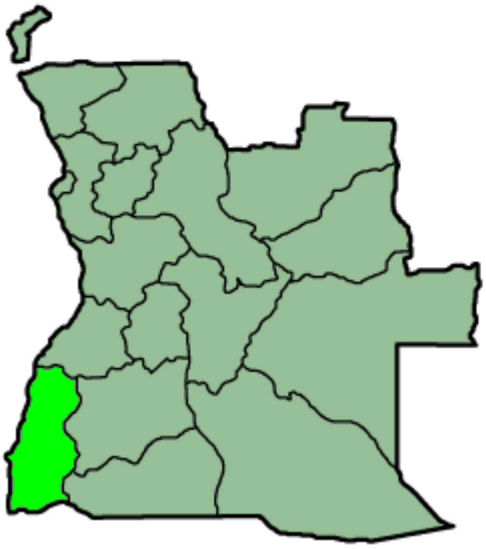


Figure 1 - Highlight of the Namibe Province in Angola

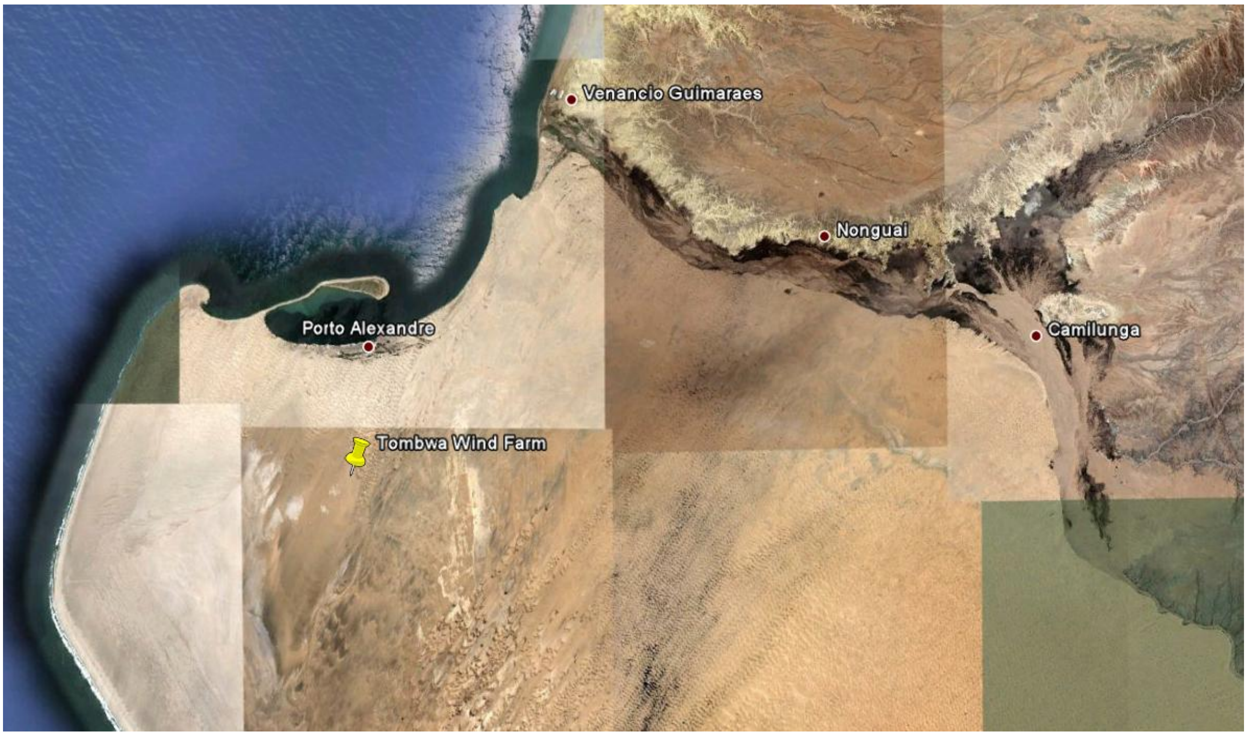


Figure 2 - Details of the project location

A.4.2. Category (ies) of project activity:

Renewable energy generation connected into the grid.

Sectoral Scope 1. Energy Industries (renewable - / non-renewable sources).

A.4.3. Technology to be employed by the project activity:

(A) The scenario existing prior to the start of the implementation of the project activity:

Before the implementation of the proposed project, the electricity was generated with the current mix of plants that has participation from fossil fuel plants in its operation.

The project activity reduces emissions of greenhouse gases (GHGs) by preventing the operation of power plants that use fossil fuels as an energy source. In the absence of project activity, fossil fuels could be burned in power plants that are connected to the grid.

(B) The scope of activities / measures that are being implemented with the project activity:

The technology employed by the project activity is the exploitation of wind energy to generate electricity. The wind power is used to move the blades, which power the turbines to produce electricity. This is a renewable energy source with a low environmental impact. Below are some technical details of each plant:

Tombwa Wind Farm	
Technical Data	**Value**
Installed Capacity (MW)	100
Turbine Model	V90 – Class III
Turbine Provider	Vestas
Load Factor (%)	46,67
Net Energy ($MW_{average}$) – Project Activity	47
Hub height (m)	80
Additional Dispatched Energy (GWh/year)	185.802
Amount of turbines	50

Table 1- Technical data of Tombwa Wind Power Plant

For the wind farm will be adopted 50 *Vestas* wind turbines. The wind turbines model is V90-2,0 MW, is a turbine with dynamic control of variation and three rotor blades. The turbine *Vestas* V90-2,0 MW has a rotor diameter of 100 m with a 2.0 MW generator power. The turbine has a microprocessor with control system of the blade called OptiTip ® and a Variable Concept of Speed (VCS: *Vestas* Converter System). With these qualities, the wind turbine is able to operate the rotor with a variable speed rotor per minute (RPM), helping to keep the real power at or near the rated power.

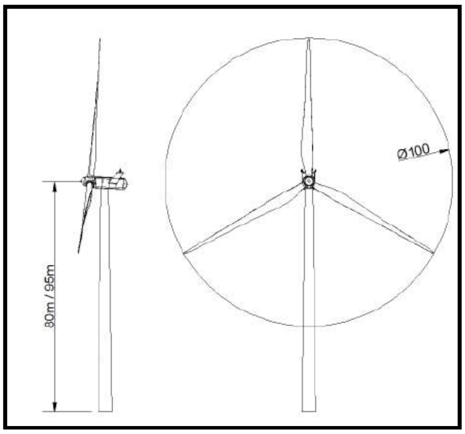


Figure 3 - Details of the V-90 turbine

Technical description of the generator

The generator is a magnet generator with three permanent phases, which is connected with a large scale converter system GridStreamer ™ directly by the stator. The V90 generator has the following characteristics:

Generator V90-2,0 MW	
Manufacturer	*Vestas*
Description	Permanently magnetized synchronous generator
Rated Power	2,0 MW
Speed	1,550 rpm
Dynamic range of speed	0-2.300 rpm
Frequency	155 Hz
Voltage	710-720 Vac

Table 2- Technical data of the generator

Technical description of the transformer

The transformer is located in a locked room in a compartment with a lightning-conductor built next to the high-voltage transformer. The transformer has two coils, three phases' electrical connections and dry-type cooling. The coils are connected in delta on the high voltage side. Below are some more specifications of the transformer:

Transformer	
Type	Dry type resin
Primary Voltage	6-35 kV
Secondary Voltage	650 V
Vector Group	Dyn5
Frequency	50/60 Hz

Table 3 - Technical data of the generator

Technical description of the converter

The converter controls the conversion of the variable frequency energy of the power generator into AC fixed frequency energy with levels of active and reactive power (and other parameters of grid connection) appropriate to the grid. The converter is in the machinery compartment and has a rated voltage of 650 V.

Converter	
Active Power	2,000 kW
Reactive Power	1,135 kVAr
Rated Supply Voltage	650 V
Rated Voltage of the Generator	710 V

Table 4 - Technical data of the converter

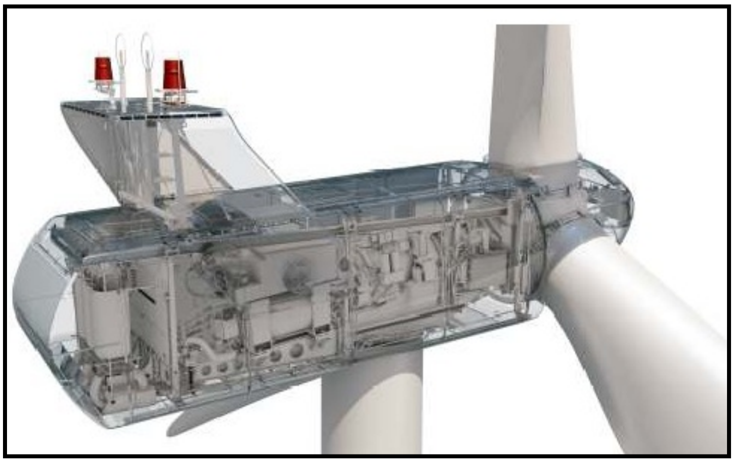


Figure 4 - Illustration of a Vestas wind turbine model V90-2.0MW

(c) The baseline scenario:

The baseline scenario of the project activity is the same scenario existing prior to the start of the implementation of the project activity.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

The proposed project activity has applied a seven years renewable crediting period. The table below summarizes the emission reductions promoted during the crediting period.

Year	Estimative of Emission Reductions (tCO2e/year)
2013	157,258
2014	157,258
2015	157,258
2016	157,258
2017	157,258
2018	157,258
2019	157,258
Total Estimated Emission Reductions (tCO2e)	**1,100,807**
Total number of crediting years	07 (renewable period)
Annual average over the crediting period of estimated reductions (tCO2e)	157,258

A.4.5. Public funding of the project activity:

There is no public funding from Annex I countries for the proposed CDM project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

For the project activity, the approved baseline methodology used is ACM0002 Version 12.1, “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”. This methodology also refers to the latest approved versions of the following tools:

- Tool to calculate the emission factor for an electricity system (ver. 2.0);

- Tool for the demonstration and assessment of additionality (ver. 5.2).

- Guidelines on the assessment of investment analysis (ver. 04).

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The criteria for the applicability of the methodology ACM0002 "Consolidated methodology for baseline generation of grid-connected electricity from renewable sources” - version 12.1, are:

• The proposed project is the construction of a new wind power plant, which will generate renewable energy to the Southern Electric Grid of Angola, in a place where other non-renewable sources (i.e. diesel based thermoelectric plants) were operating before the implementation of the project activity.

• The project activity does not involve the replacement of a fossil fuel source for a renewable source at the site of the project activity.

• The limit of the Southern Electric Grid of Angola power system, where the proposed project will be connected, is easily identified and information about the characteristics of the grid is provided publicly.

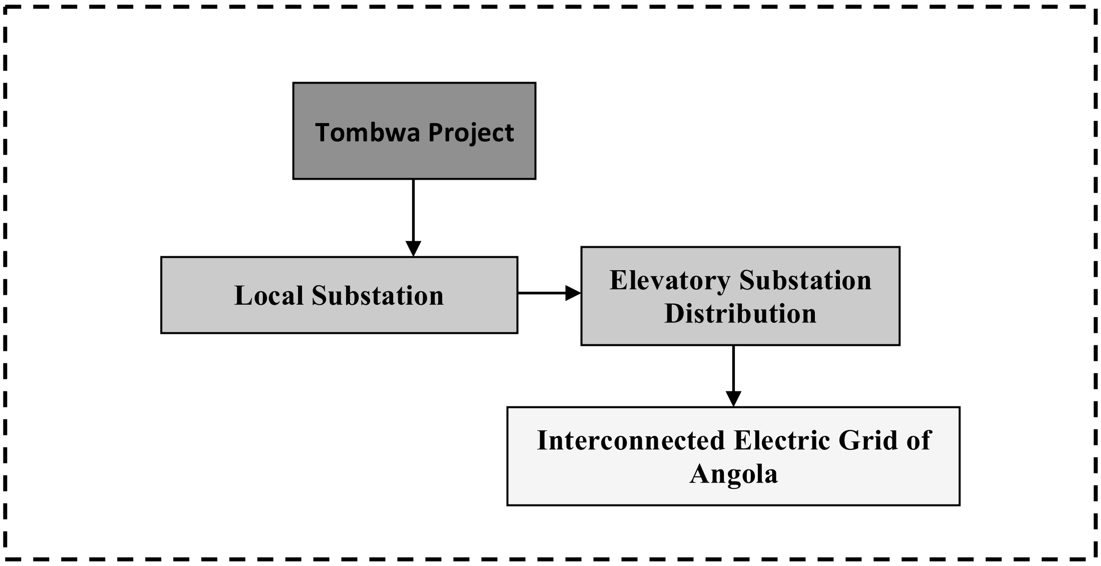
The proposed project meets all the criteria for applicability of the methodology ACM0002 version 12.1, therefore the methodology is applicable to the proposed project.

B.3. Description of the sources and gases included in the project boundary:

According to the methodology ACM0002, the spatial extent of the project boundary includes the power plant and all power plants connected physically to the electricity system, the Southern Electric Grid of Angola. The gases included in the project boundary are described below:

	Source	Gases	Included/Excluded	Justification / Explanation
Baseline	CO2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Included	Main Emission Source.
		CH_4	Excluded	Minor emission source. Not applicable to the proposed project activity.
		N_2O	Excluded	Minor emission source. Not applicable to the proposed project activity.
Project Activity	Not applicable because the project involves the installation of power plants by wind source. Thus the energy is renewable, emission-free.	CO_2	Excluded	Minor emission source. Not applicable to the proposed project activity.
		CH_4	Excluded	Minor emission source. Not applicable to the proposed project activity.
		N_2O	Excluded	Minor emission source. Not applicable to the proposed project activity.

Table 5 - Description of the sources and gases included in the project boundary


Tombwa Project
Local Substation
Elevatory Substation Distribution
Interconnected Electric Grid of Angola

Flowchart 01: Limits of the project

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

According to the methodology ACM0002, as the project activity is the construction of a new facility connected to the grid, therefore the baseline is described as follows:

The electricity delivered to the grid by the project activity, would have been otherwise generated by the operation of power plants connected to the grid and adding new sources, as reflected in the description of the combined margin (CM) in the "Tool to calculate the emission factor for an electricity system "[2], shown in section B.6.1.2.

Furthermore, the baseline is the amount of MWh produced by the renewable generating unit multiplied by an emission factor calculated in a transparent and conservative manner. In the absence of project activity, electricity was being generated by other plants connected in the Southern Electric Grid of Angola, including thermal fossil fuels. So the alternatives to the project activity, consistent with current laws and regulations, were:

Scenario 1: Implementation of the project without being registered as a CDM project activity.

Scenario 2: The continuation of the current situation, with electricity being provided by the national grid including fossil fuel plants.

The CO2 emission factor resulted from the electricity generated by the Southern Electric Grid of Angola is estimated from the records of the electricity generated and dispatched by the system operator which includes power plants that consumes fossil fuels.

The method used to perform this calculation is the dispatch analysis, which is the most appropriate to determine the grid emission factor.

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[2] Available at: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf

This information is needed for renewable energy projects connected to the grid in non-Annex I countries and implanted under the Clean Development Mechanism (CDM) of Kyoto Protocol.

As per the "Tool to calculate the emission factor for an electricity system", the following formulae is applied in order to calculate the grid emission factor.

$EFgrid,CM,y = EFgrid,OM,y \times wOM + EFgrid,BM,y \times wBM$

Where:

EFgrid,CM,y = Combined margin CO2 emission factor in year y (tCO2/MWh);

EFgrid,BM,y = Build margin CO2 emission factor in year y (tCO2/MWh);

EFgrid,OM,y = Operating margin CO2 emission factor in year y (tCO2/MWh);

wOM = Weighting of operating margin emissions factor (50%);

wBM = Weighting of build margin emissions factor (50%).

Evaluation of legal aspects

There are a range of legal and regulatory requirements for operators in the energy in the Republic of Angola. These requirements are included on the documents listed below:

- Decree 39-00 concerning Environmental Protection in the Energy Industry;
- General Environmental Law 1998;
- 1991 Model Concession Decree;
- 1976 Concession Decree;

All the realistic and credible alternative scenarios outlined above are in compliance with existing legislation and regulations of Angola and also taking into account the enforcement in the region and EB decisions on national and/or sectoral policies and regulations.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

For a description of this item is used the **"Tool for demonstration and determination of additionality ",** version 2.5.

Step 1. Identification of alternatives to the project activity, consistent with applicable laws and regulations.

Sub-step 1a. Define alternatives to the project activity.

1 - The proposed project activity implemented without its registration as a CDM project activity.

2 - The continuation of the current situation, with electricity being generated for the Southern Electric Grid of Angola, which includes thermoelectric plants based on fossil fuels.

Compliance with laws and regulations:

The alternative scenarios and the project activity are both in compliance with all regulations of the following entities: Ministry of Water and Energy, Angolan National Energy Agency, CDM Executive Board and local environmental entities. Information regarding the environmental licensing process is in section D.1 below.

Step 2. Investment Analysis

Determine whether the project activity is not:

(a) The most economically or financially attractive, or

(b) Economically and financially viable without the income from the sale of certified emission reductions (CERs).

Sub-step 2a. Determine the appropriate analysis method

The methodological tool has the following options for the investment analysis:

Option I - simple analysis of costs,
Option II-investment comparison analysis,
Option III - Analysis of benchmark index.

As a result of an analysis of the financial aspects of the project and also the economical scenario at the time of the investment decision by the project proponents, it is concluded that the Option III is the most suitable for the analysis of investment of the referred CDM.

Sub-step 2b. Option III. Reference analysis applied

As per the “Guidelines on the assessment of investment analysis (ver. 04)”, depending on the country and sector, project participants can select the relevant standard benchmark value for their proposed CDM project activity. For the purpose of determining the adjustment factor to reflect the risk of projects in different sectoral scopes, three different project categories are distinguished according to the sectoral scopes used under the CDM, as following.

Group 1:

1. Energy Industries;

2. Energy Distribution;

3. Energy Demand;

13. Waste handling and disposal.

Group 2:

4. Manufacturing industries;

5. Chemical Industries;
6. Construction;
7. Transport;
8. Mining/Mineral production;
9. Metal production;
10. Fugitive Emissions from fuels;
11. Fugitive Emissions from production and consumption of halocarbon, and Sulphur hexafluoride;
12. Solvent use.

Group 3:

14. Afforestation and reforestation;
15. Agriculture.

Therefore, for the Tombwa Wind Farm project the Group 1 is applied (Energy Industries – Sectoral Scope 1).

Investors either from the public sector or the private sector companies while investing in projects expect to earn returns which are higher than what they can expect to get by investing in risk free government bonds. Thus the expected return for any project can be expressed as risk free return plus an extra premium for the risk taken to invest in the project. Though this concept of estimating return on equity investment looks simple and straight forward, developing minimum required rates of return for a project is indeed complex.

The equity risk premium is derived from the long-term historical returns on equity in the US market relative to the return of bonds. Arithmetic means are used because they are more appropriate for estimating forward looking equity risk premiums than geometric means. A value of 6.5% is used.

In addition, the risk premium for the host country is estimated using Moody´s rating for the host country as a proxy for this risk. For those countries for which ratings by Moody´s are not available, the risk premiums were derived based on comparisons with countries with similar gross national product per capita. The national product per capita has shown to be one of the key economic determinants which have a strong statistical explanatory power for country credit ratings. The risk free rate of return is calculated based on the long-term average returns of US treasury bonds. The US stock market is used as a proxy because it has the longest well recorded data for government bonds as well as stocks.

The following table summarizes the results of the bond indexes for Angola.

Host Country	Moody´s Ratings for Bonds	Group 1
Angola	B1	13%

Sub-step 2c: Calculation and comparison of financial indicators

The spreadsheets with the estimative of the amount of the carbon credits that will be generated, the project's cash flow and the sensitivity analysis of the project are available for the DOE (Designated Operational Entity) selected and will be sent separately to the UNFCCC[3], as the rules of the Clean Development Mechanism (CDM). The cash flow was prepared according to the energy contract of 20 years, resulting in:

IRR without carbon credits	IIR with carbon credits
3,38%	4,92%

Table 6 - IRR of the project

According to the guidelines of the UFCCC EB, the benchmark adopted at the project's start date is 13%. Thus, after analysis, the IRR of the project with or without consideration of the return of the carbon credit did not reach the benchmark. In conclusion, the project presents barriers to investment by existing alternatives more attractive to invest.

Revenues from carbon credits are instruments of great importance for entrepreneurs to overcome the barriers faced, improving the quality of investments and consequently encouraging future investment in other projects to generate clean energy.

Sub-step 2d: Sensitivity analysis

To demonstrate whether the conclusion regarding the economic attractiveness above is robust and provides a valid argument in favor of additionality, a sensitivity analysis has been conducted in accordance with EB 51, Annex 58.

Variables which constitute more than 20% of either total project cost or total project revenues, including the initial investment cost, or have a material impact on the analysis, have been identified below. For the sensitivity analysis were adopted variations of 10%, positive and negative, for the following key parameters:

- Investment;
- Cost of operation and maintenance;
- Energy tariff;
- Load Factor.

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[3] United Nations Framework Convention on Climate Change.

Load Factor (%)

To estimate the load factor of a wind power plant is necessary to conduct a series of procedures. The first step is to use the calculations of the average annual wind regimes in the region where the project will be installed in order to estimate the potential Aeolian - electric usable for power plant. To elaborate this study it is necessary the use of wind speed maps, geographic information system tools and calculations of performance and energy generation for a typical wind farm. In the process, the following scheme is followed.

- General arrangement with the location of the plant, planialtimetric map with cartographic representation of the contours and the structures surrounding the core, including the delineation of the land and the transmission system;
- Memorial descriptive of the plant, detailing its main technical features including the data of the transmission system;
- Simplified general one-line electric diagram;
- Simplified study containing data from at least 3 (three) years, referring to the readings of wind speed and direction, histograms, frequency of occurrence and duration curve, to support the determination of the load factor of the wind farm.
- Study showing that the project have no interference with other wind farm in the turbulent region (region at a distance of 20 times the height of the obstacle, considering the prevailing wind direction) caused by turbines of the new plant;
- Wind speed measurements certification and estimation of the energy production of the plant, issued by an independent certification part, based on data series of at least 3 (three) years.

The parameters shown are those that most influence the project's cash flow and its variation will cause impacts on the internal rate of return of the project.

Variables which constitute more than 20% of either total project cost or total project revenues, including the initial investment cost, or have a material impact on the analysis, have been identified below and been subjected to reasonable variation range of ±10%:

1. Volume of Production

2. Operation & Maintenance Cost

3. Investment Cost (equity and debt)

The variations required, in each parameter, to reach or exceed, the IRR, are not considered viable due to numerous factors.

Step 3. Barrier Analysis

According to the guidelines of the additionality tool, it is not necessary to perform the analysis of barriers, if opting for the financial analysis, so step 3 does not apply.

Despite that the additionality of the proposed project shall be determined through a financial analysis, it is assumed that some relevant barriers are imposed to the development of the project, and consequently shall be included for transparency and consistency reasons.

An investment in Angola faces a number of barriers that would make this project activity a very unattractive investment proposition, in the absence of the carbon credits revenue. To appreciate this, it is important to provide the context in which energy investments are made before describing the specific categories of barriers in detail.

Country risk

In the Dun and Bradstreet *International Risk and Payment Review* (May, 2005), Angola was ranked as 'very high risk' — and only slightly below the worst category 'highest risk' — of 19 assessed countries. No other current or potential sector within the same region has an investment risk ranking equal to or worse than Angola.

Technical challenges

In addition to the country and commercial risks and the geographic cost disadvantage, the project is not particularly easy from a technical point of view. Difficulties in gathering and operating the Tombwa Wind Farm project HPP are imposed. Several international consultancy firms, constructors and specialized labors were needed, as the lack of these professionals and its technologies are considerably sensed in the host country of the project.

As a result of the presented above, it is clear that the primary motivation, if not the only reason to put capital at risk in the Angola energy sector rather than in an alternative and/or common type of investment elsewhere, would be to produce the renewable energy to the grid and thereby produce the emission reduction benefits.

The combination of these factors makes the project a considerably more marginal investment proposition for the project developer in comparison with different project opportunities. As this is a marginal investment opportunity, and because of the technological concerns presented, Tombwa Wind Farm project is clearly not a credible or realistic baseline scenario and therefore the emission reductions that would result from this project would indeed be additional.

Step 4: Common practice analysis

As recommended by the UNFCCC EB, the project proponent is required to establish that the project activity is not a common practice in the relevant country and sector, by applying the guidance for the investment analysis of the *Tool for the demonstration and assessment of additionality*.

The Tombwa project will be the first CDM project of its kind in terms of technology and scale in Angola. There are no similar activities in Angola that rely on a broadly similar technology, in addition there are no projects with similar scale taking place or being planned.

Sub-step 4b. Discuss any similar options that are occurring:

No other large wind project in Angola faces the range of barriers identified for the proposed Tombwa project, since its design foresees considerably large civil works, application of state-of-the-art engineering process and off-boundary technology, therefore not possessing the relevant and necessary characteristics to undertake a plausible comparison.

Currently, the benefit of the CDM is recognized by the government of the country as an important incentive for implementing renewable energy projects in Angola, enabling greater participation of these sources in the Angolan energy matrix.

According to the assessment of the tool for demonstration of additionality, the proposed project meets all the steps and sub-steps in a satisfactory manner, been the project additional and not a common practice in Angola.

CDM consideration

As described in the guidelines on the demonstration and assessment of prior consideration of CDM, all new project activities, with start date on 2 August 2008 or later, the project participant shall inform the host DNA and the UNFCCC secretariat by writing about the beginning of the project activity and its intention to make it a project activity under the CDM.

Such notification must be made within six months from the starting date of the project activity and must include the precise geographic location and a brief description of the proposed project.

The project proponent sent the letters of prior consideration of CDM to the mentioned entities, respecting the period presented in the guidelines and copies of letters are available with the DOE.

Impact of CDM Registration

The benefits available from the approval and registration of the project activity as a CDM activity may be summarized as:

- Anthropogenic greenhouse gas emission reductions;
- The financial benefit of the revenue obtained by selling CERs, which include inter alia:
    - Improve the prospects for financing the proposed project;
    - Help to diminish the higher risks associated with the investment decision;
- Formal international recognition of the investors' pioneering efforts to produce renewable energy
- International prominence of the project for Angola;

The Government of Angola considers the Tombwa Wind Farm project to be of national importance and the cornerstone of its plans simultaneously to the development of the country's renewable energy supply. Nevertheless, the financial challenges and the implementation barriers identified above have proven to significantly hinder the project participants' willingness to go ahead with an investment of this scale.

The CDM benefits would allow the Government of Angola to convince the project participants to accept the higher commercial, technological and political risks associated with this investment compared with other different and low risk investment choices in Angola.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Project Activity Emissions

The proposed project is not based on hydroelectric or geothermic energy, and therefore it is not necessary to consider the greenhouse gas emissions of the project, in accordance with the guidelines established by the ACM0002 methodology (PEy = 0).

Baseline Emissions

The baseline is the MWh produced by the generating unit multiplied by an emission coefficient (measured in tCO2e/MWh) calculated in a transparent and conservative way, called the combined margin (CM), which consists of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the methodological tool "Tool to calculate emission factor for an electricity system ". To calculate the baseline, should apply the six steps below:

STEP 1. Identify the relevant electricity systems.

STEP 2. Select a method to determine the operating margin (OM).

STEP 3. Calculate the operating margin emission factor according to the selected method.

STEP 4. Identify the group of power units to be included in the build margin (BM).

STEP 5. Calculate the build margin emission factor.

STEP 6. Calculate the combined margin (CM) emissions factor.

According to the tool mentioned above, for wind projects, the following weights should be used in the calculations:

wOM= 75%

wBM= 25%

The baseline emissions (BE_y *in* tCO_2) are the product of grid emission factor ($EF_{grid,CM,y}$ *in* tCO_2/MWh), multiplied by the generation of electricity from the project activity (EG_y *in* MWh), as follows:

$$BE_y = EF_{grid, CM, y} \cdot EG_{PJ,y} \qquad \textit{Equation 01}$$

Where:

BE_y: baseline emissions in year *y*.

EG_y: electricity dispatched to the Southern Electric Grid of Angola by the proposed project in year *y*

$EF_{grid,CM,y}$: combined margin CO2 emission factor of the grid during year *y,* calculated using the latest version of the “tool to calculate the emission factor for an electricity system”.

Calculation of $EG_{PJ,y}$

The project activity is the construction of a new wind farm plant connected into the grid, so:

$$EG_{PJ,y} = EG_{facility,y} \qquad \textit{Equation 02}$$

Where:

EGy: electricity dispatched to the Southern Electrical Grid of Angola by the proposed project in year *y*

$EG_{facility,\, y}$: Amount of net electricity generation supplied to the grid by the plant in year y (MWh / year).

Leakage Emissions

No leakage emission is considered.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	Cap_{BL}
Data unit:	MW
Description:	Wind farm plant installed capacity prior to the implementation of the project activity.
Source of data used:	Project’s site.
Value applied:	0 MW
Justification of the choice of data or description of measurement methods and procedures actually applied :	The project activity is a new power plant. No others renewable energy plant went into operation prior to the implementation of the project activity.
Any comment:	-

B.6.3. Ex-ante calculation of emission reductions:

The baseline methodology considers the determination of the grid emission factor, in which the project activity is connected, as the core data to be determined in the baseline scenario. In this case the project activity is connected to the Southern Electrical Grid of Angola.

Calculation of the “Operating Margin Emission Factor – OM” ($EF_{grid,OM\text{-}DD,y}$)

The emission factor by the dispatched method is calculated as follow:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \qquad \textit{Equation 03}$$

Where:

$EF_{grid,OM-DD,y}$ = Dispatch data analysis operating margin CO2 emission factor in year *y* (tCO2/MWh)

$EG_{PJ,h}$ = Electricity displaced by the project activity in hour *h* of year *y* (MWh)

$EF_{EL,DD,h}$ = CO2 emission factor for grid power units in the top of the dispatch order in hour *h* in year *y* (tCO2/MWh)

$EG_{PJ,y}$ = Total electricity displaced by the project activity in year *y* (MWh)

h = Hours in year *y* in which the project activity is displacing grid electricity

y = Year in which the project activity is displacing grid electricity

Thus, the average operating margin emission factor the year 2009 is:

$EF_{grid,OM-DD,y} = 0.946\ tCO_2/MWh$

Calculation of the "Build Margin Emission Factor” $\left(EF_{grid,\ BM,\ y}\right)$

According to the methodology applied, the build margin emission factor (BM) also needs to be determined:

$$\mathbf{EF_{grid,BM,y}} = \frac{\Sigma_{i,m}\mathbf{EG_{m,y}}\ .\ \mathbf{EF_{EL,m,y}}}{\Sigma_{m}\mathbf{EG_{m,y}}} \qquad \textit{Equation 04}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO2 emission factor in year *y* (tCO2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

$EF_{EL,m,y}$ = CO2 emission factor of power unit *m* in year *y* (tCO2/MWh)

m = Power units included in the build margin

y = Most recent historical year for which power generation data is available

Calculation of the "Baseline Emission Factor" ($EF_{grid,CM,y}$)

Finally, the baseline combined emission factor (combination of operating margin and build margin) is calculated by a weighted average formula, whereas for wind farms the weight is 75% for operating margin and 25% to the build margin as defined in the tool. Therefore, the result will be:

EFgrid,CM, y = 0,946 tCO2/MWh * 0,75 + 0 tCO2/MWh * 0,25 = 0,7095 tCO2/MWh • BEy =

= 185,802 MWh * 0,7095 tCO2/MWh = **157,258 tCO2**

The emissions reductions (**ER**) for this Project activity are:

$\mathbf{ER_y = BE_y - PE_y}$	***Equation 05***

Where:

ER_y = Emission reductions in year *y* (t CO_2e/yr)

BE_y = Baseline emissions in year *y* (t CO_2/yr)

PE_y = Project emissions in year *y* (t $CO2_e$/yr)

The baseline emissions are proportional to the electricity dispatched to the grid during the duration of the project. The baseline emissions due to displacement of electricity are calculated by multiplying the baseline emission factor (EFgrid, CM, y) and the electricity generated by the project activity.

$\mathbf{BE_y = EG_{PJ,y} . EF_{grid,CM,y}}$	***Equation 06***

BE_y = Baseline emissions in year *y* (tCO2/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO2 emission factor for grid connected power generation in year *y* calculated using the latest version of the tool.

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	EG_y
Data unit:	MWh/year
Description:	Energy supplied to the grid by the plant in the year y.
Source of data to be used:	Energy meter installed in the project and measurements made by official institution taken in accordance with the procedures established by the local government.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	185,802 MWh/year
Description of measurement methods and procedures to be applied:	The energy dispatched by the project's activity will monitored using official measurements in accordance with the procedures established by the sector.
QA/QC procedures to be applied:	This data will be used to calculate emission reductions. The data will be archived monthly (electronic) and will be archived during the crediting period and two years later. The data from energy meters will be measured by the power plant meter and from the database of the local grid to verify the consistency of the data.
Any comment:	

Data / Parameter:	$EFgrid,CM,y$
Data unit:	tCO_2/MWh
Description:	Grid combined margin emission factor
Source of data to be used:	Data provided by the energy administration agency.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.8463
Description of measurement methods and procedures to be applied:	The combined build margin emission factor will be calculated, as showed above.
QA/QC procedures to be applied:	This data, updated, will be used to calculate ex-post emission factor. The data will be archived annually (electronic file) and kept for up to two years after the end of the project activities.
Any comment:	

Data / Parameter:	*$EF_{grid,OM,y}$*
Data unit:	tCO_2/MWh
Description:	Grid operating margin emission factor
Source of data to be used:	Data provided by the energy administration agency.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,1285
Description of measurement methods and procedures to be applied:	The combined build margin emission factor will be calculated, as showed above.
QA/QC procedures to be applied:	This data, updated, will be used to calculate ex-post emission factor. The data will be archived annually (electronic file) and kept for up to two years after the end of the project activities.
Any comment:	

Data / Parameter:	*EFgrid,BM,y*
Data unit:	tCO_2/MWh
Description:	Grid build margin emission factor
Source of data to be used:	Data provided by the energy administration agency.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The combined build margin emission factor will be calculated, as showed above.
QA/QC procedures to be applied:	This data, updated, will be used to calculate ex-post emission factor. The data will be archived annually (electronic file) and kept for up to two years after the end of the project activities.
Any comment:	

B.7.2. Description of the monitoring plan:

All the data and parameters that need to be monitored, as listed in B.7.1, will be monitored under a monitoring plan to ensure that the emission reductions are going to be properly monitored and transparently recorded.

According to the version 12.1 of the approved methodology ACM0002, the monitoring plan will involve the monitoring of electricity generation by the proposed project activity and the emission factor of the grid.

Energy Measurement

The energy generated by the project will be measured and monitored by a system of metering and billing set according to a standard procedure in all systems of power generation in Angola. The measurement system reads the energy and save the information.

This system will be installed in the control panels, which will be located in the control room or measurement cabin (central). In this system is guaranteed the inviolability of the data, which are sealed for safety after calibration.

The power generation data will be stored electronically by the project proponent and then presented on monitoring spreadsheet for analysis in the DOE's verification.

Calibration of Instruments

Standard and method of instruments calibration will be conducted in accordance to National Standard and ISO 9001:2000 article 7.6: Control Monitoring and Measuring Equipment. Calibration will be held by accredited laboratory.

Calibration period is set based on equipment usage duration, calendar schedule or combination of both. In special cases, calibration will take place when measuring equipments show deviation from its fair value. Calibration schedule for metering system will be held once per year.

Staff and Operator Training

The purpose of staff and operator training is to make sure all the personnel involved understand and know how to carry out the proper procedures for monitoring and safety.

Data Collection and Storage

The data collection will be conducted and recorded in the frequencies and periods as explained in section B.7.1. Data collection in the form of paper will be archived electronically. Regular data back-up will be conducted to guarantee the completeness of the electronic data. As per the methodology, all data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period.

The monitoring plan will be fulfilled by the project proponents, which has the responsibility for the calculation of the baseline, project activity emissions and the emission reductions each year. All data will be in the monitoring plan and will be presented in an appropriate manner to the entities involved in the CDM process.

All monitoring data will be stored during the lifetime of the project. In this case it means seven years (credit period) and more two years after its closure in accordance with the methodology. If the project can be renewed for more two periods, the data will be stored for 21 years (credit period renewed) and more two years, giving a total of 23 years of archival information

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Date of conclusion: 26/06/2011

Entity: Angola Carbon, SA

Responsible: Mr. Ricardo Leitão Machado

Email: angolacarbon@gmail.com

Phone: +244 936 795 720

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

31/10/2011 – Date of first payment of the total equity

C.1.2. Expected operational lifetime of the project activity:

50 years.

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

01/01/2013 or the date of registration of the CDM project, whichever is later.

C.2.1.2. Length of the first crediting period:

The proposed project activity considers a renewable crediting period of 07 years.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

In Angola, the project proponent who develops projects with potential to impact the environmental due to the construction, installation, expansion or operation of the enterprise, must obtain authorization from the competent environmental authority, which are represented by so-called environmental permits.

Despite of the licenses regularly issued by the environmental agencies, according to the specific characteristics of each project, and for each region of the country, other licenses may be issued so the project can be properly adjusted. It is considered that the Tombwa Wind Farm project is properly regularized to proceed with the activity of energy generation.

In the impact assessment that was developed were elaborated environmental studies including different aspect as geological, geomorphologic, hydrological, climatic, biological, beyond the demographic, health, economic and financial aspects that are relevant to the environmental and social composition of the region.

The project activity has a very low potential to negative impacts on the natural environment. The project will not significantly compromise the region's ecosystems and there will not be total removal of a micro-environment, compromising the sustainability of the native flora and fauna

In the context of country level, the implementation of the project will mean an important contribution to achieving the government efforts to diversify the energy matrix, with the input of another source of clean energy with low environmental impact.

There will be no trans-boundary impacts resulting from the project. All relevant impacts will occur within the borders of Angola and are being mitigated to comply with environmental requirements for the implementation of the wind power plant.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

All requirements requested for issuing the environmental permits have been continuously carried out by the project proponent.

The project proponent is meeting all requirements, so the environmental impact of the project activity is not considered significant.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

The local stakeholders consultation process will be held during the validation stage. Letters will be issued with details of the project activity to local stakeholders prior to the start of the validation process and will be kept open for comments.

Further information about this consultation will be fully made available on the latest version of the PDD.

E.2. Summary of the comments received:

No comments have been received so far.

E.3. Report on how due account was taken of any comments received:

Not applicable.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project activity has not received any public funding from Annex I parties.

Annex 3

BASELINE INFORMATION

Baseline emissions related information is presented in details in Section B.6.3.

Annex 4

MONITORING INFORMATION

Information related to the monitoring plan is presented on Section B.7.1 and B.7.2.

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